their observation, there can be no question that there are others which are entirely destitute of them, and have efficient substitutes. Of this character is Dictyophora vorax, discovered by Professor Leidy in 1857. The animal is oval, transparent, and fixed in its position. The interior exhibits the usual structure of rotifers, together with the powerful muscular pharynx armed with jaws, observed to be in frequent motion. From the truncated extremity of the body the animal projects a capacious delicate membranous cup more than half the size of the body. The cup is a substitute for the rotary disks of ordinary rotifers, and is used as a net to catch food. At will it is entirely withdrawn into the body with its prey. The animal feeds on smaller animalcules; and in one instance upwards of fifty of these, mostly entomostracans, were squeezed from the stomach. With extended net, the animal measures up to 1 mm. in length. It was found in the Schuylkill River, attached to stones and aquatic plants, and also was observed attached to the sides of an aquarium.

Mecznikow, in 1866, described a similar rotifer under the name of Apsilus lentiformis, found at Giessen, attached to the leaves of the Nymphaea lutea. It especially differs from Dictyophora in the possession of bristled tentacles, and a ganglion to the pouch. Recently, also, Mr. S. A. Forbes of Normal, Ill., has described a similar rotifer with the name of Cupelopagus bucinedax; but this Professor Leidy suspects to be the same as the Dictyophora.

Later Professor Leidy has discovered another remarkable form, which he has named, from the absence of rotary organs, and its restless habit, Acyclus inquietus. It was found attached to the stems of Plumatella, a ciliated polyp, on stones in the Schuylkill River. It was always single, enclosed in profuse bunches of the familiar rotifer Megalotrocha, from which it was rendered conspicuous by its larger size, resembling a giant in a crowd. For the most part, in general structure it resembles Megalotrocha; but as a substitute for the rotary disks of the latter, it possesses a large cup-like head prolonged at the mouth into an incurved beak. The cup is retractile and protrusile, contractile and expansile. When protruded and expanded, the mouth gapes widely, and the beak becomes more extended, but always remains incurved. The animal bends incessantly in all directions, and it contracts and elongates in accord with its surrounding associates. It frequently bends, almost doubling on itself, so as to bring its prehensile mouth within the play of the currents produced by the rotary disks of the Megalotrochae, while the mouth expands and contracts so as to grasp a portion of the food brought within its reach. The movements of the animal are somewhat of a grotesque character, and reminded the author of a zealous demagogue addressing a crowd, obsequiously bowing, and greedily accepting contributions. The length of Acyclus is up to 1.5 mm. in length. The embryo at the time of its escape from the egg is a worm-like body, having the mouth furnished with vibratile cilia.

The original paper is furnished with illustrations representing both Dictyophora and Acyclus.

In one instance Professor Leidy remarks, that he had the opportunity of seeing an individual of Plumatella, with outspread arms, and in its immediate vicinity a group of Megalotrochae with open disks and an Acyclus in its midst, together with two worms of the genus Dero, with extended and expanded branchial tails, all acting together in concert, apparently perfectly regardless of the presence of one another, — messmates partaking of the same repast.

RHYTHMIC MUSCULAR CONTRACTIONS.

CONTINUING those researches on the physiology of the contractile tissues to which we owe so much, Engelmann has lately been at work (*Pflüger's archiv*, xxix. 1882) on the arterial bulb of the frog's heart; selecting it as a muscular organ which contracts rhythmically on stimulation. Preliminary careful study with the aid of some of his pupils confirmed the result of all previous workers, that the bulb contains no nerve-cells. Löwit, however, just as Engelmann had finished his work, described a 'bulbus ganglion:' this led to a fresh histological examination, also fruitless, so that Engelmann finally asked Löwit to send him some of his preparations. These were received and examined. Engelmann unhesitatingly asserts that the supposed nerve-cells are nothing but endothelial elements and connective tissue corpuscles. The isolated arterial bulb is accordingly nothing but a mass of muscular, connective, and epithelial tissues; nevertheless, when filled with blood serum under a suitable pressure, it, like the apex of the ventricle, executes slow rhythmic pulsations. These cease in ten or fifteen minutes, but after a while recommence, and may continue for hours. A single sudden stimulus of moderate strength applied in any pause between two pulsations calls forth, not as in the case of the ventricle a single contraction, but a rhythmic series of such. A weaker stimulus leads to only one beat, or none. Any part of the musculature of the bulb has this property, even pieces cut off and so minute as to need a lens for their observation. It is therefore undoubtedly a property of the muscle elements themselves. The muscle is also conductive: a stimulus applied to a portion united only by a narrow uncut strand with another portion, will arouse contractions in the latter. The stronger the stimulus, up to a maximum limit, the greater the number of pulsations in the series which follows its application, and the less the intervals between the individual contractions of the series. The influence of successive stimuli at not too short (3–5″) intervals is like that observed by Bowditch on the ventricular apex. After long rest, irritability and contractility are diminished; if then equal successive stimuli be applied, of such strength that each only arouses one beat, each beat is more powerful than that which preceded it, until a maximum is reached; at the same time a weaker stimulus than that required at the end of the period of rest becomes sufficient to excite a contraction. Each pulsation nevertheless temporarily exhausts the muscle; if the stimuli follow at less than 2″ intervals, the successive results are smaller. The contraction is always maximal for the given condition of the muscle: a strong stimulus causes no more powerful contraction than a weak, provided the latter acts at all. As in other muscles, a stimulus in itself too weak to cause a contraction makes the organ more sensitive to succeeding stimuli. As a result of this, rapidly repeated (tetanizing) stimuli at first too feeble to influence the bulb may after a time make it give an occasional beat, and ultimately cause rhythmic pulsations: that is, practically continuous stimulation gives rise not to continuous but to periodic contraction. These experiments go far in support of the view which has been gaining ground for some time back, that the rhythm of the heart's action is due not to intermittence in the stimulation sent from its ganglia to its muscle fibres, but to a property of the cardiac muscle tissue itself. The paper also contains interesting experiments on the influence of warmth and cold, and of varied

pressure of its contents, upon the isolated arterial bulb. The most striking temperature observation is, that the bulb, when brought to heat-standstill at or a little above 40° C., will nearly always beat again if the temperature be still raised two or three degrees.

H. NEWELL MARTIN.

LETTERS TO THE EDITOR.

Algae and spray markings.

INCIDENTAL to a note in Nature (xxvii. 46) on Invertebrate casts *versus* algae in paleozoic strata, the writer would call attention to the fact, that he has seen many track-like markings made by dried sea-weeds blown along the shore. In some cases a series of parallel indentations, as if some animal had walked along, were made by the stiff projections of the rolling plant. These algae tracks and markings are very similar to many fossil tracks which have been figured.

Forms similar if not identical with those described by Billings as Arenicolites spiralis from St. John's, Newfoundland, have been seen by the writer to be formed on the beach by the spray. This was especially observed last autumn at Marblehead Neck. The spray dashing over a projecting rock, and falling on the wet sands left by the retreating tide, produced a series of drop and ring like markings in the sand, varying in size from minute drops to those one or two inches in diameter. This corresponds, as regards size, with the specimens of Arenicolites collected by the writer at the Newfoundland locality. The common form of the larger spray markings is that of a ring, with a raised centre and a depressed border, surrounded by the displaced sand. The appearance is as if the drop fell like a partly closed bell of a jelly-fish, and then expanded outward in every direction, carrying the sand with it, but leaving the central portion untouched. These forms would probably be somewhat modified by the next tide, causing variations in the structure, if not obliterating the forms for the most part. As in Newfoundland, so on this modern beach, the impressions are seen crowded together, as well as singly. (See *Can. nat.*, (2), vi. 478; *Geol. survey Canada, pal. foss.*, ii. 77; *Amer. journ. sc.*, (3), iii. 223.)

M. E. WADSWORTH.

Cambridge, Mass., Jan. 9, 1883.

Geology of Lake Superior.

I am pleased to learn from a communication published in your number of Feb. 9, and signed A. R. C. Selwyn, that the present head of the Geological survey of Canada has arrived at conclusions with regard to the geology of the Lake-Superior region precisely similar to those reached and published by Foster and Whitney over thirty years ago.

That it would have been well for the Canada survey, and for geological science generally, if more attention had been paid by Mr. Logan and his assistants to the results of the survey carried on along the south shore of the lake by the U.S. geologists, during the years 1848 to 1850, will, it is thought, become apparent to every geologist who reads a work prepared by Dr. Wadsworth and myself, soon to appear in the bulletin of the Museum of comparative zoölogy, and entitled 'The azoic system and its subdivisions.'

J. D. WHITNEY.

Cambridge, Feb. 12, 1883.

Rock disintegration in hot, moist climates.

Some remarks of Nordenskiöld, in his 'Voyage of the Vega,' pp. 707–713, relating to precious stones, suggest the thought that the marked differences which occur as to the manner and rate of the weathering of granitic rocks at the north and at the south can hardly be so familiar to European scientific men as they are to American observers. At the south it is common enough to find soils that have been formed 'in place,' from the thorough and deep-seated chemical decomposition of the rocks on which they rest; while at the north, well-marked disintegration of this sort is rarely met with, even in places where the observer is not perplexed and confused by the mechanical results of glacial action. The subject has often been alluded to by American geologists, working in our southern states, notably by Professors Kerr of North Carolina, and Stubbs of Alabama, who have expressed themselves in the following terms: Speaking of the geologic formation which, "after hugging the east side of the Appalachian chain of mountains and forming some of the most valuable farming lands of the Atlantic states, enters the central eastern part of Alabama," Professor Stubbs says, "The rocks which by disintegration have given the soils of this section are mainly granites, gneisses, feldspars, hornblendes, mica-schists, etc.; and much the greater part of the section is covered by soils which have resulted from disintegration of the above-mentioned rocks *in situ*. And here I may remark a notable feature of these soils, — a feature which cannot fail to arrest the attention of every northern geologist: viz., that decomposition of these rocks in southern latitudes has proceeded much farther than with the same rocks in higher latitudes, and therefore has given us deeper soils. It is difficult to find in the north a soil over a few feet deep; while here it is not uncommon to find in railroad-cuts, wells, etc., disintegrated strata to the depth of thirty, fifty, or even seventy-five feet. This can be accounted for to a large extent by climatic influences. The warm waters, charged with carbon dioxide, percolating throughout the year the easily permeable strata, act continuously as a chemical agent in the work of disintegration; while farther north not only the amount of water, the temperature, and the chemical activity are reduced, but for one-half of the year the soil is locked up by frost from all access of decomposing agencies."

The influence of these soils of disintegration upon the agriculture of the regions in which they occur, has often been noticed; and their bearing upon the history of the use and manufacture of commercial fertilizers in this country is no less clearly marked. It would seem to be plain, that disintegration such as this, when accompanied with or followed by denudation, would readily account for the accumulation, and, so to say, concentration in 'pockets,' or other places of rest, of any heavy or refractory minerals which were originally contained, dispersed, in the native rock; and that among the multitude of individuals thus thrown together there would be much greater likelihood of finding superior specimens than can be obtained by searching the comparatively meagre deposits that are formed at the north.

The statement of Nordenskiöld, above referred to, is here given in condensed form.

"Precious stones occur in Ceylon mainly in sand-beds, especially at places where streams of water have flowed which have rolled, crumbled down, and washed away a large part of the softer constituents of the sand, so that a gravel has been left which contains more of the harder precious-stone layer than the originally sandy strata or the rock from which they originated. Where this natural washing ends, the gem collector begins. He searches for a suitable valley, digs down a greater or less depth from the surface to the layer of clay mixed with coarse sand resting on the rock, which experience has taught him to contain gems. . . . The yield is very variable, sometimes abundant, sometimes very small. . . . Sapphires are found much more commonly than rubies. . . . The precious stones occur in nearly every river valley which runs from the mountain-heights in the interior of the island down to the lowland. . . . But some one perhaps will ask, Where is the mother-rock of all these treasures in the soil of Cey-